Student Difficulties and Teaching Strategies**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Teacher Handout**

**Introduction:**

In science, students can have difficulties with key concepts that may be abstract, counterintuitive, and even difficult to grasp. As a teacher it is important to address misconceptions with good teaching strategies to help students learn and achieve success. We will be going over the major student difficulties in the Characteristics of Electricity unit.

**Misconceptions:**

1. Difficulty reading the electrostatic series.

Students may find that the list is counterintuitive as a “strong” hold on electrons should be on the top instead of the bottom. Reorganizing the chart and modeling how to use the list can overcome this difficulty.

**Electrostatic Series**

**Weak hold on Electrons**

**Strong hold on Electrons**

Glass

Wool

Fur

Lead

Silk

Paraffin Wax

Ebonite

Copper

Bras

Sulphur

Sulphur

Brass

Copper

Ebonite

Paraffin Wax

Silk

Lead

Fur

Wool

Glass

**VS.**

**Strong hold on Electrons**

**Weak hold on Electrons**

2. “Static electricity” is electricity which is static (not moving). This is a misnomer of the word static, as static electricity is caused by an imbalance in protons and electrons, using the Van de Graff demonstration can help clear this misconception.

3. Materials become positively charged by losing electrons not protons. In general the protons and neutrons do not move as they are within the nucleus of the atom. (This is still an oversimplification for grade 9 students as there are conductors where all the current is flowing in the form of protons). A balance beam diagram or hands on activity as seen below can help in understanding this concept.

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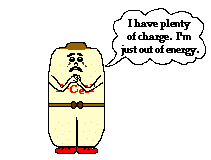
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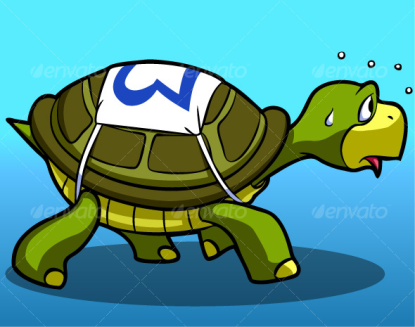
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Positive Charge Neutral Charge Negative Charge

4. Batteries never run out of charge, they run out of energy. A common sense way of thinking is that the battery supplies the charge and once the battery runs out of charge the circuit no longer works. This may originate from “rechargeable batteries”. However, for every electron that leaves a battery at one terminal another one enters at the other, so batteries never run out of charge. The animation below shows how batteries supply energy in a circuit. A comparison to a water pump may also help students correct their mental model.

<http://www.furryelephant.com/player.php?subject=physics&jumpTo=ee/1D2s1> (Animation)

<http://faraday.physics.utoronto.ca/IYearLab/Intros/DCI/Flash/WaterAnalogy.html> (Circuit/Water pump comparison)

5. Current measures how fast electrons move. This is false, as wires are already full of free electrons. They move along the wires very, very slowly but everywhere at the same time. Current really measures how many electrons pass a cross section. To address this misconception we can give the students a racing analogy. Suppose that there was a very large turtle race with millions and millions of turtles on a very wide race track then the current is how many turtles cross the finish line in a certain amount of time.

6. Difficulty understanding the difference between AC and DC. Alternating current voltage is changing voltage (positive and negative terminal) and direct current voltage is unchanging voltage. They may believe that electrons are constantly moving back and forth but may not understand that there is no net movement. The youtube video below clearly outlines the difference between AC and DC as well as showing that typically only AC is coming through all the wires but special circuits convert AC to DC.

http://www.youtube.com/watch?v=HL9mog2YYUY

**Conclusion:**

The characteristics of electricity unit will be challenging for many students as it requires students to understand an abstract concept that goes against their common ways of thinking. It is crucial to understand students’ misconceptions and use effective teaching strategies that promote learning. Good luck!